

Handheld LIBS Analysis in Nuclear Material Processing

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Laser-Induced Breakdown Spectroscopy (LIBS) utilizes short, high-energy laser pulses to ablate material off a sample surface and generate a high-temperature plasma. As the plasma cools down, the excited species within emit a characteristic optical spectrum that is recorded by a spectrometer, and the elemental constituents of the sample under investigation can subsequently be identified. Due to its simplicity and ability for multi-elemental analysis, LIBS has been a very attractive spectroscopic tool for analytical chemistry for a broad range of samples with unknown compositions, that is especially suitable for harsh environments where laboratory setting and/or proper sample preparation are not readily available.

In this work, LIBS has been introduced in a nuclear production facility in Los Alamos National Laboratory (LANL) to perform analytical chemistry assays on actinide containing materials. Portable Handheld (HH-) LIBS analyzers (Z903, SciAps Inc.) allow for high-quality analytical measurements with no sample preparation, even in a radiologically contaminated environment. We demonstrate that the limit of detection of HH-LIBS analyzer can be as low as tens of ppm inferred from Fe impurity in Ce-host matrix (as Pu surrogate) that features highly complex LIBS emissions. This implies that, along with fast outcome (less than 10 minutes), LIBS can not only provide rapid identification of impurities on various stages during nuclear processing but also offer complementary approaches on, for example, go/no-go decisions to filter out the condition that requires further examination via ultrahigh sensitive ICP-analysis. We will also discuss the possibility of developing quantitative analysis.